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## What do Spanish Engineering Students Think about Innovation and Entrepreneurship?

Mónica Edwards, Marta Fernández-Diego, Fernando González-Ladrón-de-Guevara



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# What Do Spanish Engineering Students Think About Innovation And Entrepreneurship?

Mónica Edwards <sup>a</sup>; Marta Fernández-Diego <sup>b</sup>, Fernando González-Ladrón-de-Guevara <sup>b</sup>

<sup>a</sup> INGENIO (CSIC-UPV), Valencia (Spain)

moed@ingenio.upv.es

<sup>b</sup> Dept. of Management, 7D Building 4th floor, PO Box: 22012

Universidad Politécnica de Valencia

46071, Valencia, SPAIN

## Abstract

This paper analyzes the interrelationships between creativity, innovation and entrepreneurship as key enablers of an entrepreneurial and innovation-oriented culture. Empirical results of exploring perceptions and opinions about these three concepts are presented, using a sample of 121 engineering students. The findings show that the majority of students perceive the traditional linear model of innovation and consider innovation strongly related to creativity but moderately related to entrepreneurship. There are contradictions between the students' self-perceptions as entrepreneurs, their high desirability to start a new firm and their work preferences after graduation, which are principally to get a job in a private company and become public servants. Their low willingness for mobility and the poor contribution of the education system in developing their innovation and entrepreneurial competences constitutes other relevant obstacles for improving an entrepreneurial and innovation-oriented culture.

## Keywords:

Engineering students, perceptions, innovation, entrepreneurship, creativity, competences.

# 1 Introduction

Creativity, innovation and entrepreneurship are seen as engines of an entrepreneurial culture which drives forward the competitiveness and socio-economic development (Mueller & Thomas, 2001; EC, 2006; Bessant & Tidd, 2007; Stam, 2008). In this sense, the European Community has recognised the need to strengthen its capacity to build effectively an entrepreneurial culture compared with the superior performance of USA economy (Beugelsdijk, 2007; EC, 2008a,b; Bosma et al., 2009). Several initiatives –as the *Green Book Entrepreneurship in Europe* (EC, 2003), the *Entrepreneurship Action Plan* (EC, 2004) and, more recently, the *Declaration on the European Year of Creativity and Innovation* (EC, 2008a) have been adopted to encourage and promote an “entrepreneurial mindset” at different levels of human activity. How education can be an instrument to develop a more innovation-oriented society throughout this “entrepreneurial mindset” is a major issue of policy concerns (Galloway et al., 2005; EC, 2008b; Bosma et al., 2009).

However, Brown & Ulijn (2004), Berglund & Holmgren (2006), Stam (2008), among others, have indicated the existence of some conflicts and tensions in the intersection of entrepreneurship education policy and practice. Many questions have been discussed within the current curricular reform impelled by the European Higher Education Area (EHEA): How can creativity, innovation and entrepreneurship be understood under the conceptual umbrella of transferable entrepreneurship competences/competencies? How do creativity, innovation and entrepreneur culture interrelate? How to carry out key entrepreneurship competences/competencies attending the specific context of different careers?

Despite the wide acknowledgment that innovation and entrepreneurship are important forces shaping the changes in the economic landscape, our understanding of their relationship is still far from complete (Wennekers & Thurik, 1999; Brown & Ulijn, 2004; Stam, 2008). For example, by comparing the Global Entrepreneurship Monitor (GEM) and the Global Innovation Scoreboard (GIS) rankings, it can be observed that high levels of entrepreneurship in several countries are not correlated with high levels of innovativeness or economic development (Bosma et al., 2009; Archibugi, Denni & Filippetti, 2009). Some studies (Davidsson & Wiklund, 2001; Arundel & Hollanders, 2006; Hollanders, 2009) suggest that two main constraints may be: 1) Entrepreneurship

analysis compared at macro, meso and micro level; and 2) indicators' limitations, for example, coverage and scale innovation. However, empirical evidence explains that cultural differences rather than economic variables play a fundamental role in explaining this dissimilarity (Thomas & Mueller, 2000; Noorderhaven et al., 2004; Wennekers et al., 2005). An ample literature deals the influence of perceptions and beliefs as facilitators or barriers hampering the development of an entrepreneurial culture (Brown & Ulijn, 2004; Veciana, Aponte & Urbano, 2005; Beugelsdijk, 2007), where culture is defined as a set of shared values, beliefs, and expected behaviors (Franke, Hofstede & Bond, 1991; Samli, 2009).

Even thought, innovation and entrepreneurship are seen as dynamic and holistic processes that can be present in individuals and organizations, but they are different domains; innovation is not necessarily related to entrepreneurship *and viceversa* (e.g., many start-ups base their business ideas on imitation or arbitrage without creative or innovative scopes). Indeed, the concept of entrepreneur is much older than that of innovator, and not innovative people are entrepreneurial (Wennekers & Thurik, 1999; Brown & Ulijn, 2004). On other hand, creativity is still a peripheral issue in the extensive research on entrepreneurship and innovation (Rauch & Frese, 2007).

In addition, entrepreneurship has been traditionally considered to be a Business School topic mainly linked to the creation of new ventures and self-employment (Gorman, Hanlon & King, 1997). For example, the majority of the entrepreneurial courses offered focus on business venturing skills in spite of creativity and innovation competences. Accordingly, the education system may face either individuals who can manage a business but with no idea of how to develop a product or nurture innovation within their environment, or individuals with a great talent and not a clue on what to do with it. This narrow perspective of entrepreneurship contrasts with an increased demand of new capabilities for attending the general impact of ICT uses and advanced trends in freelancing, corporate entrepreneurship, collaborative entrepreneurship (Miles, Miles & Snow, 2005; Ribeiro-Soriano & Urbano, 2009), sustainable entrepreneurship (Dean & McMullen, 2007) and strategic entrepreneurship (Kuratko & Audretsch, 2009).

The conventional Schumpeterian definition of an entrepreneur as innovator continues being one of the main core approaches to entrepreneurship (Schumpeter, 1935; Drucker, 1993), but it has evolved over time as the world's economic structure has changed and becomes more diverse and complex (Hébert & Link 1989; Lundvall, 2008). The new

context of the knowledge economy or, more properly, the *learning economy* and the economic and socio-cultural transformations experienced during the last decades have led to a re-evaluation of the concept and roles of innovator, manager and entrepreneur (Gorman, Hanlon & King, 1997; Berglund & Holmgren, 2006; Seneges, 2007; Lundvall, 2008).

A distinction is commonly made between Schumpeter Mark I, where small entrepreneurs act as the engines of innovation; Mark II, that emphasizes capabilities of large corporations, and Mark III, that introduces networking among firms and knowledge institutions into the innovation scenarios (Swedberg, 2002). New market opportunities (e.g., renewable energies, sustainability, climate change, creative and cultural industries, etc.), the growth of business services –with special relevance of Knowledge Intensive Business Services and the emerging phenomena of open innovation represent important challenges for innovation and entrepreneurship research (Chesbrough, 2003).

Regarding the question of which entrepreneurship competences can really develop an entrepreneurial mindset in individuals (with focus in the three Schumpeterian scenarios) and what does it means, it is necessary to deep into our understanding of the meanings and interrelations of creativity, innovation and entrepreneurship. Nevertheless, they are still fuzzy concepts that have been given overlapping or hidden aspects which it is necessary to clarify (Gartner, 1989; Stam, 2008).

According Bessant & Tidd (2007:40) the practice and study of both innovation and entrepreneurship can realized from three different perspectives: a) personal or individual; b) collective or social, which stresses the contribution of teams and groups and, c) contextual, which focuses on the structures, climate, processes and tools. From the individual perspective, innovation has mainly been considered by research as a trait (innovativeness) and creativity has rarely been studied. However, recent meta-analysis of the literature on personality approach has documented an ample criticism, considering that it is one of the more controversial areas of entrepreneurship research (Zhao & Seibert, 2006; Zhao, Seibert & Lumpkin, 2010). Markman (2007:67) comments that *“although past literature on individual differences in entrepreneurship is instructive it offers neither an inclusive theory non practical guidance regarding what competencies are needed to start a new company”*.

About this matter, the focus of recent research has shifted to the study of those competencies and competences that entrepreneurs need for becoming successful or to respond to opportunities (Hayton & Kelley, 2006; Man, 2006; Fastré & Van Gils, 2007). In this scope, entrepreneurship neither is it seen as a distinct psychological characteristic of an *entrepreneurial personality* rather a complex interaction of different skills, knowledge, affective factors and traits (Winterton, Delamare-LeDeist & Stringfellow, 2005; Markman, 2007). It clarifies the question of whether entrepreneurship can be taught and the myth that entrepreneurs are born, not made (Gorman, Hanlon, & King, 1997; Kuratko & Hodgetts, 2004; Senge, 2007). Creativity, innovation and “*entrepreneurial mindset*” can be learned and taught as part of the process of personal development and can be applied to all aspects of life.

Though the development of an innovative and entrepreneurial mindset should be found in all professions, this work has focused in the engineering area taking into account that technological innovation is in the core of the policy agenda (Landau & Rosenberg, 1986). Engineers are often associated with innovation but paradoxically they tend to create far fewer enterprises than business graduates (Fayolle, 1996; Fayolle, Gailly & Lassas-Clerc, 2006). For this reason, it is paying special attention to the systematic integration of entrepreneurship and technological innovation into scientific and technical studies (Link & Siegel, 2007; EC, 2008c). Within this context, the purpose of this paper is double: a) to expose an analytical scheme for contributing to a major understanding of the interrelationships between creativity, innovation and entrepreneurship and, b) to present some empirical evidence exploring the engineering students’ perceptions on innovation and entrepreneurship.

Although there is an ample literature on students’ perceptions of entrepreneurship, investigations including engineering students are scarce (Tkachev & Kolvereid, 1999; Veciana, Aponte & Urbano, 2005; Souitaris, Zerbinati & Al-Laham, 2007; Guerrero, Rialp & Urbano, 2008). Several studies focused on the positive impact of students’ perceptions of entrepreneurship as a career choice (Autio et al., 2001), the role of the university environment for inhibiting or facilitating entrepreneurial behaviours and entrepreneurial attitudes (Fayolle, 1996; Lüthje & Franke, 2003). In this sense, even though studies on the students’ perceptions aligned with the search of opportunities are very relevant, the research focus on competences can also add valuable information. Individuals may be aware of the existence of an opportunity but may not possess the

competences to exploit it and, consequently, research on competences approach can be more useful to integrate psychological and behavioural scopes with environmental and contextual factors.

From this perspective, our study has boarded the following questions:

- What do students understand by innovation? Do they relate creativity and innovation with entrepreneurship?
- Which are the students' perceptions of competencies and competences of an entrepreneur?
- To what extent do students perceive that innovation and entrepreneurship competences are developed or improved by the education system?
- Which are their work preferences after graduation and why?
- What do they think about work mobility?

The remainder of the paper is structured as follows: second and third sections summarize a set of theoretical conceptualizations on creativity, innovation and entrepreneurship and their interrelationships, introducing an analytical framework of innovation and entrepreneurship competence. Then, we describe the details of our empirical study, including the methodology and sample and, lastly, we expose the results and the principal conclusions, commenting their implications and perspectives for future research.

## **2 Entrepreneurship, innovation and creativity: a synergistic or hidden relationship?**

### ***2.1 What is the meaning of entrepreneurship and what are its connections with innovation and creativity?***

A review of the theories surrounding entrepreneurship and innovation reveals an immense amount of material, expanding from multiple perspectives: economic, managerial, psychological and socio-cultural (Veciana, 2007). Entrepreneurship can be considered as the activity realized by entrepreneurs for the creation of new enterprises and organizations (including family business, Small and Medium-Sized enterprise – SMEs and big corporations) together opportunities identification and self-employment.

other authors focuses on opportunity (Shane & Venkataraman, 2000; Short, 2010). An entrepreneur is who discover, evaluate, and exploit opportunities and has the ability to turn ideas into action. Entrepreneurship is defined as the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, physic, and social risks, and receiving the resulting rewards of monetary and personal satisfaction. Schumpeter (1934) raises the innovator-entrepreneur figure as the central concept for entrepreneurship. This includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to achieve objectives (EC, 2006).

According to the recent policy agenda, entrepreneurship is *“a dynamic and social process where individuals, alone or in collaboration, identify opportunities for innovation and act upon these by transforming ideas into practical and targeted activities, whether in a social, cultural or economic context”*(EC, 2006b:20). Entrepreneurship is also defined as *“an attitude that reflects an individual’s motivation and capacity to identify an opportunity and to pursue it”* (EC, 2003:5). This attitude is crucial for competitiveness and can be useful to encourage innovation.

Kuratko & Hodgetts (2004) appoint the need to develop an *“entrepreneurial perspective”* in individuals with a more synergistic approach to innovation, in a dynamic process towards the creation and implementation of new ideas and creative solutions. This innovation and entrepreneurial mindset can be exhibited inside or outside an organization, in profit or not-for-profit enterprises, and in business or non business activities. This idea was in the seminal work of Drucker (1985) who made reference to an entrepreneurial society where individuals will increasingly have to take responsibility for their own self-development and the development of others. In our study we have considered of interest to explore in what extent students link innovation with entrepreneurship and both concepts with value generation and economic development.

## ***2.2 How is creativity related to innovation and entrepreneurship?***

Creativity is the background of innovation and entrepreneurship, being a potential driver to empower an innovative and entrepreneurial culture (Davidsson, 1995; Bessant & Tidd, 2007; Hollanders & Van Cruysen, 2009).



According to Florida (2002:4) creativity is multidimensional and comprises three different types: technological creativity (invention), economic creativity (entrepreneurship) and artistic/cultural creativity. In his opinion all these dimensions of creativity are interrelated, sharing a common process of thinking and reinforcing each other; economy can be seen as the result of the interrelations among technology, arts and businesses. Creative skills are important for all economic sectors and activities and not only for creative industries. In the often cited dynamic model of “*creative destruction*” (Schumpeter, 1934) personal creativity is considered the precursor of innovative behaviour and a central dimension of “*enterprising potential*” in individuals.

In the *European Innovation Scoreboard (EIS)* Hollanders & Van Cruysen (2009) have showed evidences of a positive link between increased Research and Development (R&D), design performance and innovation. The best performing countries in creativity and design are the same countries that show superior innovation performance in the EIS. These authors have appointed the need to consider design and other non-R&D activities as part of the broader approach to innovation policy as well as to the strong links between creativity and innovation.

Sternberg & Lubart (1999) defines creativity as the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints). In opinion of Sternberg and Lubart, entrepreneurship can be a form of creativity since new businesses are often original and useful. Bessant & Tidd (2007:40) have a wider vision, considering that “*Creativity is the making and communicating of meaningful new connections to help us think of many possibilities, to help us think and experience in varied ways and using different points of view; to help us think of new and unusual possibilities; and to guide us in generating and selecting alternatives*”.

The increasing relevance of the creative industries is an example of this scope, together other non-technological sectors in both manufacturing and services (Hui et al., 2005; Archibugi, Denni & Filippetti, 2009; Hollanders & Van Cruysen, 2009). The creative sector is defined as the mix of non-profit arts and for-profit creative industries, such as technology development, arts and entertainment, design, filmmaking and architecture. The creative industries are estimated to account for more than 7 % of the world’s domestic product and represent a leading sector in many OECD countries, with annual growth rates of 20% (Hollanders & Van Cruysen, 2009). Hui et al. (2005) have developed a creativity index analyzing creativity as “*a social process continuously*

*shaped and constrained by the values, norms, practices and structures of Social Capital, Cultural Capital as well as the development of Human Capital*". The accumulated effects and interplay of these different forms of capital are the outcomes of creativity which could be measured in terms of economic outputs, incentive activities and any other forms of creative goods, services and achievements. In our study we consider of interest to explore how students conceive creativity with respect to innovation and entrepreneurship and for developing entrepreneurship competences.

### ***2.3 What's the meaning of innovation and how is it related to entrepreneurship?***

Innovation has been studied in a variety of contexts, including in relation to technology, commerce, social systems, economic development, organizational change and policy construction. There are, therefore, a wide range of approaches to conceptualizing innovation in the literature, considering its evolution, models (linear, interactive, open), types (technological, non-technological, incremental, radical, disruptive, etc.) (Schumpeter, 1934; Freeman, 1982; Chesbrough, 2003; Lundvall, 2008).

Innovation typically involves creativity, but not *viceversa*: any innovation begins with a creative idea but not all creative ideas have successful implementation. Innovation can generate a valuable outcome: a new product, a new service, a new business model, a new initiative, or a new program. Innovation is creativity that adds value, which can be economic, social, psychological, or aesthetic. From this point of view, creativity by individuals and teams is a starting point for innovation (Sternberg & Lubart, 1999; Luecke & Katz, 2003). On the other hand, innovation is generally related to research and invention but the two terms are not synonymous either. Invention is the creation of new forms, compositions of matter (devices) or processes. An improvement on an existing form, product or process might be an invention, an innovation, both or none of them if it is not substantial enough. According to business literature, an idea, a change or an improvement is only an innovation when it is valuable in the market and effectively causes a social or commercial reorganization.

Innovation and entrepreneurship competences should take into account the three Schumpeterian scenarios or the three entrepreneurship paradigms proposed by Sundbo (1998), called the entrepreneurship paradigm, the technology-economic paradigm, and the strategic innovation paradigm. The *entrepreneurship paradigm* is frequently used to

describe innovation activities at the level of individual firms, it is associated with incremental innovation and a major presence in SMEs. The *technology-economic paradigm* is usually associated with innovation policies of large companies, which are users of the so-called "*mass-technologies*". The key feature of this paradigm is the significant involvement of engineers and technicians in the development of new technologies, strategic corporate entrepreneurship, strongly R&D driven business and radical innovations. The *strategic innovation paradigm* is relatively new and emphasizes on firm strategy, market conditions and broad firm competencies as factors that impact on the innovation process and performance of a firm. This approach to innovation is multifunctional and includes both technological and non-technological innovations. (Hollanders & Van Cruysen, 2009)

In the Schumpeterian tradition the role of entrepreneurship is implicit as an underlying cause of innovation. However, innovation is not solely the domain of entrepreneurs. The evolution of modern markets has seen the emergence and proliferation of professional innovators and innovation facilities controlled by established large companies, rather than entrepreneurs. Similarly, the definition of the entrepreneur has also expanded beyond its role as an innovator to embrace, among others, risk taking and managerial responsibilities. And it is important to make a distinction between "*replicative*" entrepreneurs -those producing or selling a good or service already available through other sources and really "*innovative*" entrepreneurs (Wennekers & Thurik, 1999).

### **3 Towards an integrated view of innovation and entrepreneurship competences**

In synthesis, we argue that creativity, innovation and entrepreneurship are different knowledge domains and it is assumed that they can be acquired throughout competences by individuals and organizations. As it shows in Figure 1, entrepreneurship competences embrace the intersection between competencies and competences existent in this three different knowledge fields, and they are instruments for enhancing an entrepreneurial and innovation-oriented culture (Figure 2).

Innovativeness is one of the core concepts of Schumpeter's approach to enterprising spirit (Schumpeter 1935; Drucker, 1985; Baum, Frese & Baron, 2007). But the question is that innovativeness would not be only considered as a trait but all the students would have to know basically what innovation is and acquire/develop capabilities to be

innovators. Perhaps more strictly and according to the recent scopes of policy agenda and research, we would have to say “*innovation and entrepreneurship competences*”.

The real challenge promoted by the European policy agenda is to build interdisciplinary approaches, making entrepreneurship education accessible to all students. The *Report Entrepreneurship in higher education especially within non-business studies* affirms that “*the benefits of entrepreneurship education are not limited to start-ups, innovative ventures and new jobs. Entrepreneurship refers to an individual’s ability to turn ideas into action and is therefore a key competence for all*” (EC, 2008c). The *Oslo Agenda for Entrepreneurship Education in Europe* (EC, 2006) affirms that entrepreneurship education may provide specific business skills and knowledge of how to start a company and run it successfully, but also should include the following:

- developing personal attributes and skills that form the basis of an entrepreneurial mindset and behaviour (*creativity, sense of initiative, risk-taking, autonomy, self-confidence, leadership, team spirit, etc.*);
- raising the awareness of students about self-employment and entrepreneurship as possible career options;
- working on concrete enterprise projects and activities

The development of students’ transferable or generic competences constitutes a prerequisite to empower an entrepreneurial and innovation-oriented culture.

## 4 Methodology & Samples

We have realized a survey in a sample of  $n=121$  students, comparing the answers of students that are in the beginnings of their engineering career (Group 1,  $n = 53$ ) with a sample of students who recently started a one-year specialised management program students (Master in Enterprise Organization (Group 2,  $n= 68$ ) at the Polytechnic University of Valencia. A questionnaire with 17 multi-item and closed-ended, as well as open-ended questions was designed and students were surveyed during the last week of first semester and their participation was voluntary. Demographic data in terms of gender was not considered due the scarce presence of women.

## 5 Results

### 5.1 What do students understand by “innovation”?

We created a list with the principal aspects that characterize and define innovation, considering formal definitions of the latest version of the *Oslo Manual* (OCDE, 2005) and some research works (Drucker, 1985; Landau & Rosenberg, 1986; Luecke & Katz, 2003; Bessant & Tidd, 2007; Veciana 2007). For this, we also considered the results of a previous study (Edwards et al., 2009b).

The question asked to students was: *In your opinion, what of the following aspects and features better define and characterize the innovation phenomenon? Please use the values 1 to 4 (where 1= is not related to innovation, 2= little related, 3=related, 4= very related).* Table 1 presents the results of the students’ perceptions in relation with the concept of innovation.

We conjectured that Master students would have a wider and clearer scope of innovation and would emphasize a stronger relation between innovation and entrepreneurship than initial course students. Therefore, we applied the nonparametric statistic Mann-Whitney U test (M-W) in order to detect possible differences, which is similar to the independent t test, but used when the dependent variable data are grossly non normally distributed (Corder, & Foreman, 2009). The sixth column presents the significance level (p), showing that both groups only differ significantly on the feature “Profits”. Master’ students consider that entrepreneurship is more related with an economic and/or social utility in major measure than first course students ( $p=0.032$ ). However and contrary to our assumption, there are no significant differences for the rest of students’ perceptions on innovation characteristics.

Engineering students consider that innovation is closely related to “Creativity” (3.52) and mainly consists in the application of scientific and/or technological knowledge (“Applied research”) (3.50), “Research” (3.49), “Invention” (of products, processes, techniques...) (3.46) and “Generation of technological and scientific knowledge” (3.41). In fact, these results agree with literature. Kline & Rosenberg (1986:286) affirm that students generally conceive the “*linear*” model of innovation (i.e., the research, development, production and marketing) which distorts the reality of innovation and stands in opposition of actual interactive and systemic models of innovation. Hence, students do not consider “Market” strongly related with innovation (2.60) and only moderately related with economic value topics, as “Profits” (2.81) and “Change that generates value market” (2.77).

*Finally, innovation is moderately related with entrepreneurship (3.03) and also with socio-economic development (2.87) and in minor measure with, in general, those features that form part of day-to-day management (problems resolution, continuous improvement and risk management).*

## **5.2 Which are the students’ perceptions of entrepreneurship competences?**

Similarly to the previous question, we asked the students on what competences (traits, knowledge, abilities, aptitudes, attitudes) they think are necessary for being entrepreneur. We selected and listed a set of competences according to the literature<sup>1</sup> which were valued by the students in order of importance on a scale from 1 to 5 (1= non important, 2= little important 3= quite important, 4= very important, 5= essential).

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<sup>1</sup> The EMPRETEC Model Personal Entrepreneurial Competencies (PEC) which appear to characterize the behaviour of successful entrepreneurs ACIM (2007) – EMPRETEC-model (available at <http://www.agenceacim.com/documents>)

Table 2 shows the ordered average values of these characteristics related with entrepreneurship competences. In general, students' perceptions have a scope of entrepreneurship competences are more related with a management than with the competences of an innovator profile. Both students groups perceive that the first and essential characteristic is Initiative (4.63 for Group 1 and 4.72 for Group 2). This result agrees with the traditional scope of literature review on entrepreneurship: an entrepreneur is a person who has initiative to start a business or put into practice an opportunity (Shane & Venkataraman, 2000; Veciana, 2007; Short, 2010). Other topics which have been indicated as the most important characteristics in an entrepreneur, such as "Decision-making", "Vision", "Self-motivation" and "Risks management", are also considered as "*very important*" by both students groups.

"Creativity" is considered quite important (3.67) but remains one of the last competences in order to its importance (while it appeared to be the principal attribute of innovation, as we could appreciate in Table 1). Furthermore, the students consider that innovation is little related with "Risk management" while it is very important for entrepreneurs (4.21). This topic is controversial in the literature, Schumpeter considers that risk-bearing is not an entrepreneurial function and all the risk of an enterprise is of the capitalist (see Swedberg, 2002, p. 85). Other authors, as Veciana (2007), have the opposite opinion. In this case, risks management is seen as more important for Master students (4.39) than for first course engineering students (4.05). Ethical commitment occupies the last place in their perceptions on entrepreneur's attitudes and it is coherent with the general appreciation of the entrepreneurs' profile in Spain (Veciana, 2007).

Finally, the values obtained for the Mann-Whitney U non-parametric test in the fourth column, show that both groups differ significantly in "Tenacity" ( $p=0.00$ ), "Risks

management” ( $p = 0.02$ ), “Self-motivation” and “Flexibility”, both with a significance level of 0.0.

### ***5.3 Students’ perception on the contribution of the education system to acquire/development some innovation and entrepreneurship competences***

Other question raised to students was in what extent they perceive that innovation and entrepreneurship competences are developed or improved by the education system.

Exactly, the question asked was: *In your opinion, has the education system contributed to the development of your competences to be an enterprising person? (Scale: 1. Yes, absolutely; 2. Yes, quite, 3. Few, and 4. No).*

As we can observe in Figure 3, results show a normal symmetric distribution highly skewed with mean = 1.37 and coefficient of variation = 0.804. Only 7.6% of the students have responded “yes, absolutely” and 34.7% perceive that entrepreneurship competences have been quite improved by the education system. A significant percentage (45.0%) considers that the contribution of the education has had a minor contribution and 12.7% affirm that it has had no positive effect on their competences to become an entrepreneur.

### ***5.4 Students’ work preferences after graduation***

A set of options was presented to students, asking what kind of activity they were planning after graduation: Get a job in a private company, “Become public servant”, “Open my own company”, “Work with partners” or “Freelance activity”. We have considered as entrepreneurial options the last three. These options were ordered according to their importance, from 1=more important, 2= secondly and so on.



Results show (see Table 3, the entrepreneurial options are marked in bold) that most of the students are planning to get a job in a private company (38.3%), followed by the students who wish to become public servants (27.8%). The percentage of students who think they would open their own company in the future is 22.6%. However, if these students are regrouped with those who are planning to work with partners or to do a freelance activity –this new category represents students with an entrepreneurship attitude-, the total percentage increases up to 33.9%. Table 3 also shows the results for the second option chosen by engineering students. Note that the attitude of students to entrepreneurship possibilities becomes more representative as second option (52.7%), followed by the students who wish to become public servants (25.7%) and then students who are planning to get a job in a private company (21.6%). These results are similar to the ones obtained in other studies realized by Veciana, Aponte & Urbano (2005).

In addition and with the intention of compare the answers, we asked them if they consider themselves as entrepreneurs and creative persons (scale: yes, no, a little bit) and if they have ever thought about starting their own Business/Company, with the options “yes”, “no” and “*I have not thought about it*”. Most of the students see themselves as entrepreneurs (55.48%) and creative persons (52.1%) and they have curiosity about how to start up their own business (75%). Although students’ desirability to create a new firm has increased considerably in the past decades in Spain (Veciana, Aponte & Urbano, 2005), these results show a contradiction between the desirability to create a new firm and the real work aspirations after graduation.

In practice, engineering students seem to be more *reproducers* than entrepreneurs in the practice arena. Finally, note that freelance activity is the less considered by both groups, only 1.8% of Master students have considered this option in first place and 10.9% in second one. Results in the first course students are very similar, with 6.8% as first

option and 8.2% as second one. Applying the Mann-Whitney U non-parametric test, we have found that the groups differ significantly in the issue “Get a job in a private company” ( $p=0,002$ ) but not in “Open my own company ( $p=0,733$ )”.

We asked to students about the reasons or motives that influence their work preferences. They ordered from most to minor importance (first motive, second motive, etc.) a set of alternatives which can be observed in Table 4.

In this case the results are showed considering only students first option. As we can observe in Table 4, their motives are not related with some of the typical options for entrepreneur profiles, as to get higher earnings or labour flexibility (only 9.5% of first course students for both options). Both groups consider the same main motives of their entrepreneurial work preferences, the first reason (36.1%) is that this work option really represents a wider challenge and involves major responsibility, and the second reason (22.2%) deals with self-realization and job satisfaction. Then, both groups differ: the third reason is a good environment and better working conditions for the first course students (19%) and the possibility of balancing professional and private life for Master students (20%).

### ***5.5 Students' perspectives about work mobility***

In relation with the willingness to move to another place to work, we can observe that first course students (9.9%) are less arranged to move than Master students shows (23.1%), 15.5% of the students would not be prepared to move to another place and 18% of the students are indifferent with respect to this option. In Figure 4 Significant differences were confirmed by Cramer's V tests ( $p=0.004$ ) (see Table 5). These results put in evidence one of the most important obstacles to be entrepreneur, because of the fact that opportunities can appear in any place of the world.

## 6 Conclusions

Enhancing the potential of entrepreneurship and innovation has therefore become a top priority in the European Community and places education in the foreground of the strategic framework for the integrated entrepreneurship and innovation policy. One of the most important objectives is to determine transferable competences in order to reinforce the entrepreneurial mindsets in individuals with a simultaneous stimulation of creativity and innovation. However, how these competences should be is worrisome. On one hand, the architecture underpinning research on entrepreneurship is still confuse and incomplete, with a primary focus on the economic and business content to be taught and the role of Business Schools in fostering entrepreneurship. On the other hand, the existence of different paradigms and contexts in the entrepreneurship and innovation scenarios has led to a re-evaluation of which competences are the most appropriate for the actual entrepreneur-innovator profiles. This paper intends to go above these constraints and “*the sterile debate on the definition of entrepreneurship*” (Veciana, 2007:28), exploring the interface between creativity, innovation and entrepreneurship as three interrelated but different knowledge fields.

Our study contributes with some empirical evidence on this hidden relationship. Although creativity is the background of both innovation and entrepreneurship, students consider that creativity is a characteristic of the innovation phenomena but with no similar degree of relevance as an entrepreneur competence. In fact, the majority of students have a naïf vision of innovation, linked with creativity and in part related to the traditional linear model of innovation, i.e., innovation as application of scientific and/or technological knowledge, research, invention of products, processes, techniques... In part because they do not take into account the introduction of the new products or

processes in the market or the profits which can be obtained with them, that is, the last part of the linear model.).

This circumstance seems to point to intrinsic cultural aspects (i.e., ideas and beliefs about innovation and entrepreneurship existing in the Spanish socio-cultural environment). Besides, there are contradictions between the students' self-perceptions as entrepreneurs, their high desirability to start a new firm and their work preferences after graduation. They see themselves as entrepreneurs, but they are thinking in getting a job in a private company or become public servants as first option. In addition and as much as possible, they avoid work mobility. These results, rather limited by the sample size, suggest that the culture and education system in Spain are contributing to form reproducers more than innovators and entrepreneurs. We believe that it would be interesting to extend the study to a wider sample, including female participants and other careers.

In sum, there are relevant constraints for determining entrepreneurship competences from the perspective of conciliating the policy objectives for building an entrepreneurial and innovation-oriented culture and the current European curricular reform. Meeting this goal demands aligning innovation and entrepreneurship competences and their implementation with a deeper understanding of synergies between creativity, innovation and entrepreneurship.

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## Figures:

Figure 1.

Entrepreneurship competences embrace the intersection between creativity, innovation and entrepreneurship

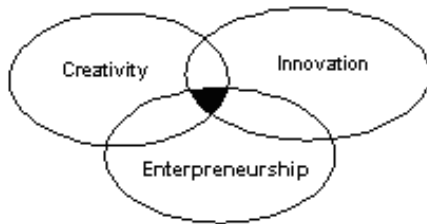


Figure 2. Concept map of competences approach to entrepreneurial and innovation-oriented culture

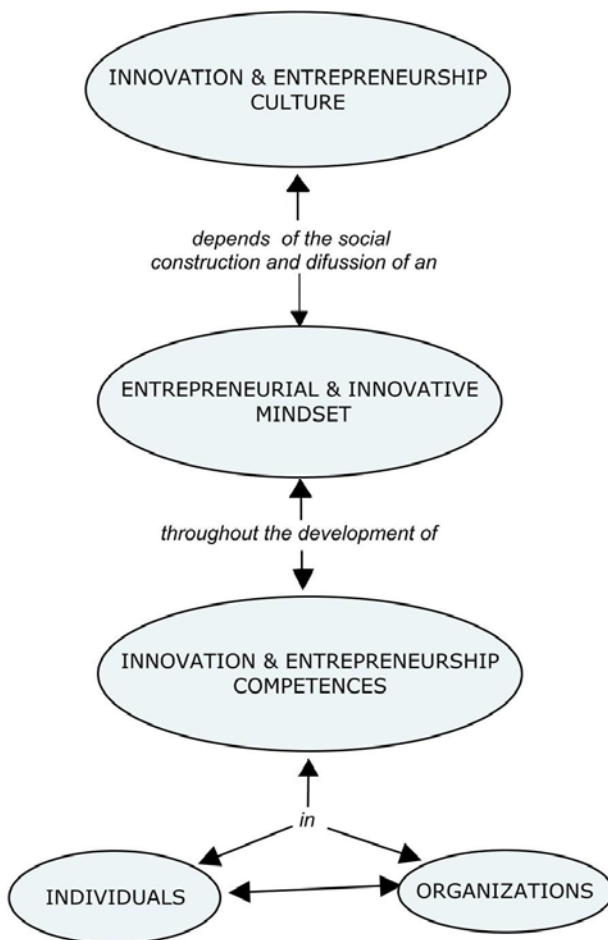


Figure 3.

Effect of education system on the development of entrepreneurship competences according to the engineering students' perceptions. Mean= 1.37; Std. Dev.=0.804

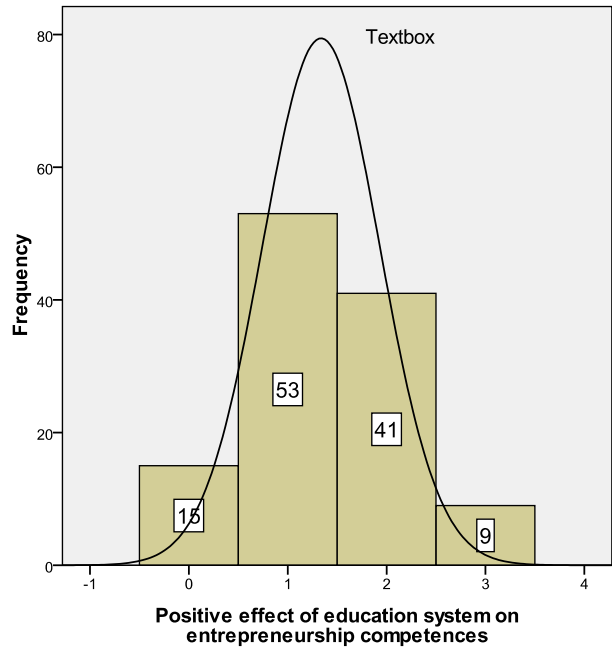
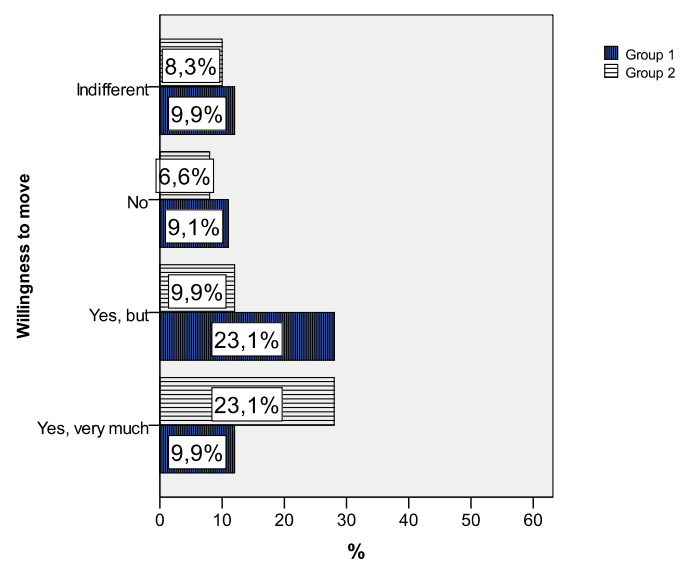


Figure 4. . Students' perspectives about work mobility.



## Tables:

Topics related to innovation	Average X	X Group 1 n=53	X Group 2 n=68	M-W Test	Asymp Sig (2-tailed)
<b>Creativity</b>	3.52	3.46	3.58	1686	0.51
Applied research	3.50	3.44	3.55	1679	0.38
Invention	3.46	3.37	3.57	1517	0.07
Generation of technological and scientific knowledge					
Research					
New products	3.41	3.31	3.52	1526	0.11
New services	3.49	3.56	3.42	1592	0.22
Originality	3.26	3.17	3.35	1567	0.19
Product Improvement	3.24	3.19	3.29	1690	0.45
Process Improvement	3.19	3.10	3.29	1645	0.39
<b>Entrepreneurship</b>	3.11	3.11	3.10	1806	0.91
<b>Profits (an economic and/or social utility)</b>	3.07	3.10	3.03	1694	0.67
<b>Change that generates value</b>	3.03	3.02	3.05	1706	0.73
Revolution					
<b>Socio-economic development</b>	2.81	2.63	3.00	1409	<b>0.03</b>
Problem resolution					
Continuous Improvement	2.77	2.62	2.94	1321	0.07
<b>Market Risk/uncertainty management</b>	3.02	3.10	2.93	1605	0.29
	2.87	2.89	2.84	1740	0.88
	2.82	2.84	2.79	1800	0.89
	2.87	3.00	2.74	1465	0.06
	2.60	2.52	2.68	1565	0.07
	2.54	2.40	2.70	1442	0.19

**Table 1.** STUDENTS' PERCEPTIONS ABOUT INNOVATION

Competences/ competencies	Average	Group 1 n=53	Group 2 n=68	p
<b>Initiative</b>	4.68	4.63	4.72	0,51
Decision making	4.54	4.50	4.58	0.37
Vision	4.34	4.39	4.29	0,23
Self-motivation	4.27	4.10	4.47	0.05
<b>Risks management</b>				
Flexibility	4.21	4.05	4.39	0,02
Critical capacity	4.12	4.25	3.96	0.05
Problem-solving	4.04	4.06	4.02	0,36
Tasks organization	4.04	4.06	4.02	0.73
Persistence	4.03	3,97	4.09	0,31
Communication skills	4.02	4.00	4.03	0.87
Negotiation				
Business intuition Leadership	3.98	3,92	4.05	0,34
Time management	3.91	3.84	3.98	0.30
Tenacity	3,87	3,77	3.97	0,24
Ability to integrated scope	3.82	3.92	3.72	0.26
<b>Creativity</b>	3.75	3,67	3.84	0,32
Empathy	3.78	3.52	4.05	0.00
Information management				
Ethical commitment	3,69	3,73	3.66	0.43
	3.67	3.75	3.59	0.27
	3.58	3,60	3.57	0.78
	3.53	3.52	3,53	0.80
	3.31	3.55	3.26	0.68

**Table 2.** STUDENTS' PERCEPTIONS ON ENTREPRENEUR COMPETENCES/COMPETENCIES

Options after graduation	First option			Second option		
	X	G 1	G 2	X	G 1	G 2
		%	%		%	%
Get a job in a private company	<b>38.3</b>	25.4	51.8	<b>21.6</b>	24.6	18.2
Become public servant	<b>27.8</b>	37.3	17.9	<b>25.7</b>	22.9	29.1
<b>Open my own company</b>	<b>22.6</b>	25.4	19.6	<b>19</b>	19.7	18.2
<b>Work with partners</b>	<b>7</b>	5.1	8.9	<b>24.2</b>	24.6	23.6
<b>Freelance activity</b>	<b>4.3</b>	6.8	1.8	<b>9.5</b>	8.2	10.9

**Table 3.** STUDENTS' WORK PREFERENCES AFTER GRADUATION

Motives of work preference	First option %	Group 1	Group 2
Wider challenge and more responsibility	36.1	28.6	46.7
Self-realization and job satisfaction	22.0	19.1	26.7
Good environment/better working conditions	2.0	19.0	0.0
Possibility of balancing professional and private life	11.0	0.0	20.0
Higher earnings	8.3	9.5	0.0
Labour flexibility	5.6	9.5	0.0
Possibility of improving one's competences	5.6	9.5	0.0
Major security and stability	5.6	0.0	6.6
Possibility of staying at your place of residence	2.8	4.8	0.0
Major prestige	0.0	0.0	0.0

**Table 4.** STUDENTS' MOTIVATIONS OF WORK PREFERENCES AFTER GRADUATION

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13,272 <sup>a</sup>	3	0.004
Likelihood Ratio	13,616	3	0.003
Linear-by-Linear Association	3,386	1	0.066
N of Valid Cases	121		

**Table 5.**